

§24. Observation of the Plasma Density Fluctuation in CHS via Monostatic Antenna Pulsed Radar Reflectometer

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Recently growing attention to the reflectometry, as the suitable diagnostic for plasma density profile reconstruction and for measurements of plasma density fluctuations, has been widely recognized.

The routine description and schematic layout of CHS pulsed radar reflectometer are given elsewhere[1]. In the reference it was shown that due to the comparatively big reflection from the vacuum break *mica* window than that from the plasma use of the time-of-flight measurement system was not allowed. To overcome this situation special new microwave technique was used. The idea of this improvement lies on the additional 'time-gating' of the reflected signals.

Various plasma experiments are made in *standard operation mode*. It is characterized by low magnetic field $B_t(0)$ (typically 0.8–0.9 T), not so high central electron density $n_e \sim 3 \times 10^{13} \text{cm}^{-3}$, various plasma axis position. Fundamental harmonic (53.2 GHz) of the ECH or 7.5 MHz ICRF (IBW) microwave radiation power is employed to build up a plasma. The target plasma is heated by 1 MW NBI or (and) by the ECH radiation power (fundamental at 53 GHz or (and) second harmonic at 106.4 GHz). To control the plasma density (n_e) both gas puffing and Ti-gettering are used.

In the regimes with the maximum density above the cut-off density, a pulsed radar relies on the total reflection of the electromagnetic waves by the plasma. The time necessary for transmitted narrow pulse to complete a round trip to the critical layer in the plasma and back to the antenna is directly measured. In low density plasmas, where the maximum density is below the critical density corresponding to the probing frequency, pulses launched into the plasma will not be reflected but pass through the plasma. They will be reflected by the inner wall of vacuum vessel, returned and detected. For the time that does not overlap with ECH pulse the agreement is rather good.

Another field, where pulsed radar can be applied, is measurement of MHD oscillations. The understanding of the nature of these phenomena gives additional information for the configuration optimization, stability and transport properties of the CHS plasma. The observation of the local plasma electron density fluctuation was performed during low- β experiments. Those oscillations could be originated from the magnetic islands rotation. As another confirmation of those idea, we present the comparison of the spectra for the magnetic probes and reflectometry data in Figure 1. Our experiments have the primary aim to check the occasion of pulsed radar operation in the helical systems. It was found that general behavior of this diagnostic tool is very close to

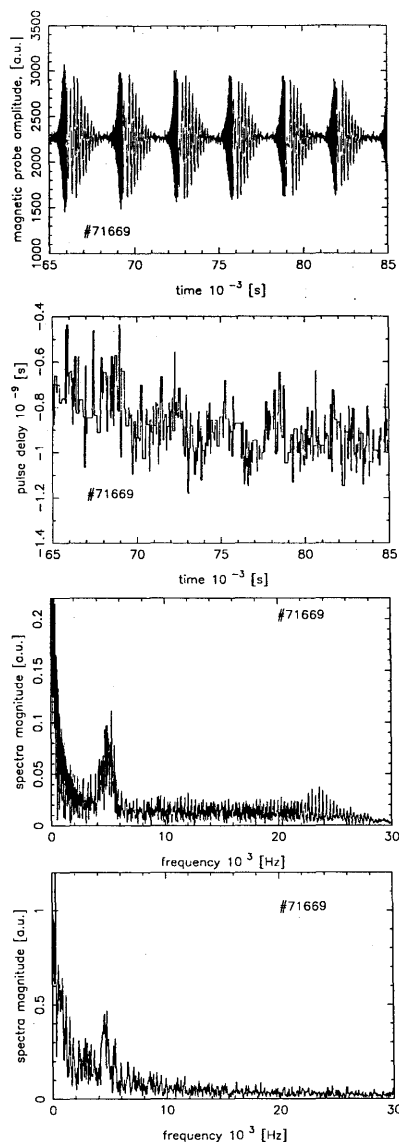


Figure 1: Comparison of the signals from the radar and corresponding spectra during 65–85 ms and of the probes for the same time window the discharge #71669

those that operate on tokamaks. Among distinctive features for the helical systems that must be certainly mentioned we must point out several items: (a) real three-dimensional topology of the reflected surfaces (it means small reflected power and additional problems with antenna arrangement, limited port access); (b) sometimes high, non-negligible shear (the deduction of the magnetic field and the effect of mode coupling becomes more difficult).

References

- [1] R.Pavlichenko, A.Ejiri, K.Kawahata, K.Matsuoka, *Jour. Plasma and Fusion Res. Series*,1 (1998) 378.